DOWN UNDER! INCORPORATING CAVE AND KARST RESEARCH INTO PRIMARY AND SECONDARY EDUCATION

Amy L. Giannotti
Terrence N. Tysall
Rima B. Franklin
The Cambrian Foundation
1234 East Concord Street, Suite A
Orlando, FL 32803
407-228-7077
amy@cambrianfoundation.org,
terrence@cambrianfoundation.org
Rima.Franklin-1@ksc.nasa.gov

Abstract

Join the Cambrian Foundation team as we highlight two of our recent research expeditions in the underwater caves of central Florida and the Yucatan Peninsula. This presentation/poster is a *must* for teachers, parents, and students alike. The Cambrian Foundation, a 501(c)(3), based in Orlando, Florida, is dedicated to research, education, preservation, and exploration of the aquatic realm. Specifically, we specialize in research and technical diving, gathering data for scientists in places where they cannot go. In addition to research and as our mission statement indicates, our other passion is education — for only when someone understands something will he or she then learn to protect it; therefore, education equals preservation. This presentation will highlight Cambrian Foundation research expeditions where youth of all ages (elementary through college-age) are incorporated and integrated into an actual field research expedition. You will see students exploring the Florida aquifer via a human ROV (remotely operated vehicle), surveying an unexplored cave in the middle of the Mexican jungle using underwater cave survey techniques, dealing with the challenges of hauling gear and equipment over difficult terrain, producing a map for a landowner in the Yucatan, and learning firsthand about the geology, ecology, and biology in the world beneath their feet. As the students have learned, cave research — especially in remote areas — is challenging, but collecting data crucial to protecting these endangered habitats is priceless.

The Cambrian Foundation was founded in 1994 upon the premise that research, education, preservation, and exploration of aquatic habitats will help maintain these ecosystems for future generations. The Cambrian Foundation, a not-for-profit 501(c)(3) corporation, has served the public and scientific communities in many ways. As specialists in deep, mixed-gas technical diving, our expertise lies in collecting data from environments where people cannot typically go. We are actively involved in surveying and mapping underwater cave systems, documenting new cave species, and monitoring water quality in many endangered subterranean systems from central Florida to the Yucatan Peninsula and Bermuda. These data are then used to provide information to scientists about the health of our aquifer, the hydrogeological features of submerged ecosystems, and the pathways and

patterns of groundwater flow.

In addition to research, our other passion is education. Each research expedition always has several educational components to it, whether it means visiting school and community groups, creating daily updates on our Web site that highlight our expedition experiences, or having young people join us in research, we are committed to sharing with others about the importance of caring for our delicate groundwater systems. Our staff is composed of microbial ecologists, marine ecologists, ocean acoustic engineers, marine geologists, aqueous geochemists, professional educators, environmental scientists, environmental filmmakers, and biospeleologists. The two cave conservation education projects featured at the 2005 National Cave and Karst Management Symposium in Albany, New York, highlighted the Central Florida Karst Project, and the Sistema Camilo, Akumal, Mexico expeditions.

The Cambrian Foundation has been working in the Wekiwa Springs and Apopka Blue cave systems as part of the Central Florida Karst Project since 1999, and as such, has done a number of outreach and hands-on educational events related to the research within this cave system. Since 1999, our educational outreach program has reached over 150,000 people ranging from conference attendees at the annual meetings of the Boston Sea Rovers, National Association of Cave Diving, National Speleological Society, American Geophysical Union, to Rotary and Kiwanis Clubs, to various primary and secondary school classrooms, and major research universities. Research in the Wekiwa and Apopka Blue Systems is always a highlight of these presentations as it is such a unique environment (diverse microbial colonies, difficult access to the cave, high flow system, presence of fossil remnants, newly documented species of stygobitic macrofauna, proximity to urbanization and development, and the like). Approximately 450 young people have been educated in the field using the caves of central Florida as experiential learning opportunities. Details regarding the dates and locations of these presentations can be found on the Cambrian Foundation Web site (http://www.cambrianfoundation.org) under the Events Calendar.

In addition to providing free, educational outreach programs to schools and community groups that request our presentations, we also provide the means by which young people can learn about these systems in a hands-on learning style. During this project, students learned firsthand about the world beneath their feet by using a research diver with surface communications gear as a human-remotely operated vehicle, or human-ROV. In this way, the young people were able to communicate directly with a researcher in the underwater cave systems and to experience this extreme underwater environment from the safety of land above. This human-ROV lets young people learn kinesthetically via live video and audio feed to the surface about the geology, ecology, and hydrology of the underwater cave environments. It also affords them the opportunity to explore a place few people have ever been.

Certainly the most unique thing that the Cambrian Foundation does is to allow and encourage students of all ages to not only participate, but to be incorporated onto our research expeditions. Participating in expeditions and field programs enables young people and their teachers to experience a real-world working research expedition as they are integrated onto the Cambrian Foundation team as research assistants. This helps them to understand the importance of protecting these delicate interconnected aquatic systems while at the same time actually *experiencing* what it is like to work in a particular profession within the broad field of environmental science. For the past four years, students from the Fuqua School in Farmville, Virginia, have joined us on a variety of expeditions ranging from underwater archaeology off the east coast of Florida to cave survey and exploration in the jungles of the Yucatan Peninsula.

Sistema Camilo, currently the 14th longest surveyed underwater cave system in the world, lies near the village of Akumal, Mexico, approximately 70 miles south of Cancun. Students participating on this international research expedition were exposed to a variety of new scientific, cultural, and historical settings in which their learning took place. The goals of the educational portion of this expedition were threefold: First, by incorporating high school students into a working field expedition, we provided an unparalleled opportunity for hands-on experiential learning. Second, we focused on teaching the local population about the importance of water protection, conservation, and proper use by talking with several landowners in the area and sharing what we have learned in the previous years through our research. Third, by having our

students update the Web site on a daily basis, they educated people throughout the world about the serious issues facing this and other cave systems.

Prior to their arrival in Mexico, students began learning about the terrestrial and aquatic biodiversity unique to this part of the Yucatan. Once the expedition began, students were immersed in applied algebra, geometry, biology, oceanography, hydrogeology, and Mayan culture. Each day began by assisting the research dive team in mixing gas, preparing cylinders, logging pre- and post-dive information, assembling gear, and launching divers in the remote cenotes that connect this underwater labyrinth. Since the students were not certified cave divers, we provided them with an analog activity to understand what challenges the research divers face while working in this environment. Fortunately, the Cambrian Foundation's reputation among landowners in the Akumal area has afforded us a unique opportunity to let our young research assistants survey and map a cave on private property that, according to the landowner, had never been explored. In order to appreciate the difficulties faced by divers trying to collect data in these systems, communication during the survey was limited to hand signals and messages written on slates. Our team of ten students worked for five days to explore and survey the lines they laid in this cave system, eventually producing a map for the landowner. In addition to mastering the tasks of compass navigation, running reels, GPS navigation through the jungle, and nonverbal communication, the students also collected water quality data, both in their cave and in the cenotes of Sistema Camilo, critical to understanding how these caves are capable of supporting such a unique assemblage of species in an environment devoid of sunlight. These data also helped illustrate what happens during speleogenesis, especially in submerged karst systems where a halocline is present. They were also tasked with the responsibility to explore the surrounding jungle in search of new recharge areas and karst features that supply this watershed.

This expedition was documented by Genesis Productions in a documentary produced for *Virginia Currents*, a PBS series based in Richmond, Virginia. We are very grateful to our staff and supporters who make these expeditions possible, and who take the time to educate young people today about the importance of appreciating and caring for their environment. Fuqua School, a small private school in south central Virginia, is to be commended for their continued participation and support in letting students learn outside the classroom. Lessons learned on these and other Cambrian Foundation projects will hopefully inspire young people to protect and care for the delicate resources our planet has to offer.

Author biographies:

Amy L. Giannotti, President of the Cambrian Foundation, graduated from the University of Virginia in 1999 with a masters degree in environmental science/aquatic ecology. Since then, Amy has spent the last several years instructing on both the high school and college levels, developing curricula for environmental science programs, and encouraging students and teachers to participate in research expeditions. Amy was the first teacher to bring her students on a Cambrian Foundation expedition back in 2002, and after that rewarding experience, she left the teaching profession to focus on experiential field learning opportunities for people of all ages.

Terrence N. Tysall is the Chairman of the Board for the Cambrian Foundation. He has an undergraduate degree in environmental science, and he is currently enrolled at Texas A&M University pursuing a masters degree in biospeleology under the direction of Dr Tom Iliffe. His thesis research will focus on the biodiversity of anchialine caves in Bermuda. Terrence has over 30 years of diving experience in every underwater environment the planet has to offer and is an advisor to many scientific and technical diving research organizations. As the founder and past president of the Cambrian Foundation, he is inspired by the opportunity to teach young people in outdoor classrooms in various corners of the world.

Dr Rima B. Franklin, a microbial ecologist, is a graduate of the University of Virginia's environmental sciences program. She earned her PhD in 2004 and is presently completing her postdoctoral fellowship at NASA's Kennedy Space Center Life Sciences Laboratory. Rima serves as an advisor to the Cambrian Foundation, and she is the principal investigator on several projects studying the importance of microbial communities in food web structure of submerged cave systems.